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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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WELLS ST. JOHN P.S.
601 W. FIRST
SUITE 1300
SPOKANE, WA 99201-3828

EXAMINER

KIELIN, ERIK J

ART UNIT

PAPER NUMBER

2813

DATE MAILED: 05/20/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/754,926

Applicant(s)

AHN ET AL.

Examiner

Erik Kielin

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 23 April 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 2-10 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 2-10 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 23 April 2002 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 7. 6) ☐ Other: _____

DETAILED ACTION***Information Disclosure Statement***

The information disclosure statement filed 4/23/02 fails to comply with the provisions of 37 CFR 1.97, 1.98 and MPEP § 609 because the some of the references have not been provided with dates in accordance with 37 CFR 1.98(b)(5). Also the MPEP 609 states,

“Each publication must be identified by publisher, author (if any), title, relevant pages of the publication, and **date** and place of publication. The date of publication supplied must include at least the **month and year** of publication, except that **the year of publication (without the month) will be accepted if the applicant points out in the information disclosure statement that the year of publication is sufficiently earlier than the effective U.S. filing date and any foreign priority date so that the particular month of publication is not in issue.**” (Emphasis added.)

The IDS has been placed in the application file, but only the references initialed by Examiner have been considered. Applicant is advised that the date of any re-submission of any item of information contained in this information disclosure statement or the submission of any missing element(s) will be the date of submission for purposes of determining compliance with the requirements based on the time of filing the statement, including all certification requirements for statements under 37 CFR 1.97(e). See MPEP § 609 ¶ C(1).

Examiner acknowledges that Applicant has provided both month and year for **some** of the references in the supplemental IDS, filed 4/23/02 (Paper No. 7), that were not considered in the previous IDS, filed 8/6/01 (Paper No. 2). However, Applicant has only provided the year of other references, and has failed to provide a statement, **as indicated above**, regarding the

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absence of the month. Accordingly, these reference fail to meet the proper requirements set forth and have not been considered.

Drawings

1. The proposed drawing correction and the proposed substitute sheets of drawings, filed on 4/23/02 have been approved. A proper drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The correction to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 10, 2, and 4-8, are rejected under 35 U.S.C. 103(a) as being unpatentable over US 5,923,056 (**Lee et al.**) in view of the basic text of **Vossen and Kern**, Thin Film Processes II, Academic Press: Boston, 1991, pp. 80-81, 108-109, 113-115, 188, 200.

Regarding independent claim 10, **Lee** discloses forming a variety of semiconductor devices including MOS, flash EPROM, capacitors, DRAMs, etcetera having a doped metal oxide, which may be a silicon-doped aluminum oxide (col. 1, line 66 to col. 2, line 10; col. 3, lines 19-40). An **example** is disclosed (cols. 5-6, "EXAMPLE 1") wherein the silicon-doped

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aluminum oxide is formed by sputtering from a target containing aluminum with 1% silicon using sputtering (i.e. co-evaporating silicon and aluminum) in a chamber having argon and oxygen wherein evaporation is generated by glow discharge plasma. **Lee** discloses the “conductive material” (called the “gate 13” in **Lee**) on the deposited silicon-doped aluminum oxide (called “gate dielectric 18” in **Lee**). Note that silicon is semiconductive.

Lee does not disclose that specifically silicon monoxide and aluminum oxide are co-evaporated, but does expressly state that the doped metal oxide films may be formed using “a conventional deposition technique such as sputtering ...” (col. 2, lines 15-21).

The basic textbook of **Vossen and Kern** teaches conventional techniques for forming thin films including forming a mixed or alloy film using “two-source sputtering, with one source for one alloy component and the other source for the second component.” (See p. 200, section entitled “*Targets*.”) **Vossen and Kern** also teaches numerous examples of mixed films formed using separate evaporative sources on p. 108-109, Table II. Sources for aluminum oxide (Al_2O_3) and SiO are also taught to be known on pp. 113-115, Table III as well as the composition of the vapor upon evaporation. Note also that even if SiO_2 is used as the evaporative source, that **SiO is the main component of the vapor -- not SiO_2** . So even if SiO_2 is thermally evaporated, SiO is the vapor species formed.

It would have been obvious to one of ordinary skill at the time of the invention to use a silicon monoxide source and an aluminum oxide source to form a silicon doped aluminum oxide film as a matter of design choice because it appears that the choice of SiO and Al_2O_3 sources are well known and will result is the same silicon-doped aluminum oxide as that disclosed in **Lee**, and because **Lee** teaches “a conventional deposition technique such as sputtering” will work and

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because the use of separate sources to form a mixed or alloy layer is conventional, as taught by **Vossen and Kern**.

Applicant could overcome the rejection by providing evidence that the specific use of silicon monoxide and aluminum oxide provides unexpected results in the Si-doped aluminum oxide film relative to that source used in Lee. Presently there is no such evidence of record.

Regarding claim 2, the omission of O₂ is obvious since the oxygen component is already provided in the known SiO and Al₂O₃ sources. One of ordinary skill would be motivated to leave out the oxygen since it is already provided in the sources used.

Regarding claims 4, **Vossen and Kern** also teach thermal evaporative systems for SiO (silicon monoxide) at pp. 98-99, especially Fig. 9, are conventional. It would have been obvious to one of ordinary skill at the time of the invention to use thermal evaporation of SiO, as a matter of design choice since **Lee** teaches conventional deposition methods apply and because **Vossen and Kern** teaches thermal evaporation specifically of SiO is conventional.

Regarding claims 5 and 6, **Vossen and Kern** teach that thermal evaporation is conventionally carried out using, *inter alia*, electron beams (guns) (pp. 80-81), and that ion beams are conventionally used for sputter deposition (p. 188). It would have been obvious to one of ordinary skill at the time of the invention to use electron beam or ion beam sputtering of Al₂O₃ by an electron beam, as a matter of design choice since **Lee** teaches conventional deposition methods apply and because **Vossen and Kern** teach that electron and ion beams are conventional for deposition of thin films.

Regarding claim 7, the specific combination of thermal evaporation of SiO and “one or both of electron gun evaporation and ion beam evaporation” of Al₂O₃ is also a matter of design

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choice for the reasons indicated above -- especially since electron gun is just an example of a thermal evaporation method, as taught by **Vossen and Kern**.

Regarding claim 8, **Lee** discloses the silicon substrate (col. 5, line 56).

4. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Lee** in view of **Vossen and Kern** as applied to claim 1 above, and further in view of JP 60-167352 A (**Fujisada**).

The prior art of **Lee** in view of **Vossen and Kern**, as explained above, teaches all of the features of the claims except for using a sapphire source for the aluminum oxide.

Fujisada teaches the benefits of preventing injurious impurities from being incorporated into sputter-deposited aluminum oxide films by using a sapphire target, specifically for use in semiconductor device applications. (See Abstract.)

It would have been obvious to one of ordinary skill at the time of the invention to use a sapphire source as the aluminum oxide source in the method of **Lee** in view of **Vossen and Kern** to prevent contamination of the deposited film, as taught by **Fujisada**.

5. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Lee** in view of **Vossen and Kern** as applied to claim 10, above, and further in view of **Wolf**, Silicon Processing for the VLSI Era, Vol. 1 : Process Technology, Lattice Press: Sunset Beach, CA 1986, p. 5.

Lee does not specifically state that the silicon substrate is "monocrystalline."

Wolf teaches that integrated circuits are formed on monocrystalline or “single crystal” silicon substrates (p. 5, first paragraph under section entitled “Manufacture of Single Crystal Silicon.”)

It would have been obvious to one of ordinary skill at the time of the invention to use the notoriously well-known monocrystalline substrates, as **Wolf** teaches that monocrystalline is always used over other forms of silicon to enable sufficient carrier lifetime in semiconductor devices.

Response to Arguments

6. Applicant's arguments filed 4/23/02 have been fully considered but they are not persuasive.

Applicant argues there exists no suggestion or motivation in “either in the references themselves or in the **knowledge generally available to one of ordinary skill in the art**, to combine the reference teachings” (emphasis added). Examiner respectfully disagrees for the reasons indicated in the body of the rejections. For further clarification, **Lee** suggests using a conventional technique, which a suggestion that the exemplary embodiment is not limiting to the method of deposition and motivates one of ordinary skill to use any conventional sputtering method -- not just the exemplary one included. The general textbook of **Vossen and Kern** goes to provide proof of what is generally known to one of ordinary skill. Since **Vossen and Kern** specifically teaches that it is known to use a at least two targets of different materials to form an mixture thereof, one expressly knows from such teaching that, if a silicon-aluminum oxide is to be formed that this may be formed by any targets containing silicon, aluminum, or oxygen,

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merely by common sense. Accordingly, the combination teaches and/or suggests the instant invention and the combination of references is proper.

Applicant also appears to argue that the specific targets SiO and Al₂O₃ to form a silicon-aluminum oxide must somehow expressly be shown in order to provide the suggestion to use such a combination. For the reasons just indicated, Examiner respectfully disagrees that such suggestion is the only such suggestion leading one of ordinary skill to the desired layer. Rather, the common sense suggestion provided by **Vossen and Kern** is sufficient to suggest one of ordinary skill specifically what materials must appear in the targets used to form a given layer -- specifically that each of the elements in the layer may be present. In the instant case these elements are Al, Si, and O. By the text of **Vossen and Kern**, the express suggestions are to use any of the following targets: (1) a single target containing Si, Al, and O (e.g. aluminosilicate); (2) a first target using Si and a second having Al and O; (2) a first target containing Si and O and a second containing Al; (3) a first target containing Si and O (e.g. SiO or SiO₂) and a second target containing Al and O (e.g. Al₂O₃); or (4) separate Si and Al targets or a combined SiAl target used while reactive sputtering in an O-containing atmosphere. This is the common sense suggestion of the text of **Vossen and Kern**.

Further in this regard, Applicant has not provided evidence to suggest that the specific combination of targets of specifically SiO and Al₂O₃ produce an unexpected result in the resulting Si-Al oxide layer produced. Accordingly, it would appear that Applicant has acquiesced, thereby suggesting that there exists no unexpected results. Evidence is especially required since **Vossen and Kern** expressly indicates that the main gaseous component in a vapor produced from a SiO₂ target is SiO, which is Applicant desired gaseous species. For at least this

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reason, the resulting silicon-aluminum oxide arising from a conventional SiO target or and SiO₂ target, either combined with an Al₂O₃ target by co-evaporation/co-sputtering would be expected to have the same properties. It is not Office policy to assume unexpected results. Rather, Applicant has the burden of proof. (See MPEP 2145.)

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

The article **Manchanda** et al. "Gate quality doped high K films for CMOS beyond 100 nm: 3-10 nm Al₂O₃ with low leakage and low interface states," IEDM 1998, 6-9 December 1998, pp. 605-608, discloses the use of silicon-doped aluminum oxide for semiconductor device applications.

US 6,300,202 B1 (**Hobbs** et al.) teaches the use of silicon-doped aluminum oxide for semiconductor device applications (col. 2, lines 48-65).

US 6,280,810 B1 (**Nakamura** et al.) teaches co-sputtering of, *inter alia*, SiO and Al₂O₃ to form protective films (col. 4, lines 49-64).

8. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO**

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MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication from examiner should be directed to Erik Kielin whose telephone number is (703) 306-5980 and e-mail address is erik.kielin@uspto.gov. The examiner can normally be reached by telephone on Monday through Thursday 9:00 AM until 7:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri, can be reached at (703) 306-2794 or by e-mail at olik.chaudhuri@uspto.gov. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications.

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EK

May 8, 2002



OLIK CHAUDHURI
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800